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(56) Documents Cited
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(71) Applicant(s)
Samsung Electronics Co Limited
(Incorporated in the Republic of Korea)
416 Maetan-dong, Paldal-gu, Suwon-city,
Kyungki-do, Republic of Korea

(72) Inventor(s)
Hee-Won Seo

(74) Agent and/or Address for Service
Dibb Lupton Alsop
Fountain Precinct, Balm Green, SHEFFIELD, S1 1RZ,
United Kingdom

may not be clear # of slots

(54) Abstract Title
Adjusting activity intervals according to remaining battery capacity in a mobile communication terminal

(57) The battery life of a mobile communication terminal which performs activities at particular time intervals, or slots, is extended by controlling a slot cycle according to a remaining capacity of the battery. The terminal has a slot cycle index table for storing a plurality of reference levels and their corresponding slot cycle indexes. As a slot cycle change mode is set, the terminal detects the battery level in a prescribed level check cycle and compares the detected battery level with the reference levels in sequence. If the detected battery level is higher than a selected one of the reference levels, the terminal sets the slot index to a value corresponding to the selected reference level. Further, the terminal sets the slot cycle index corresponding to a longest slot cycle, when the detected battery level falls outside of a reference level range.

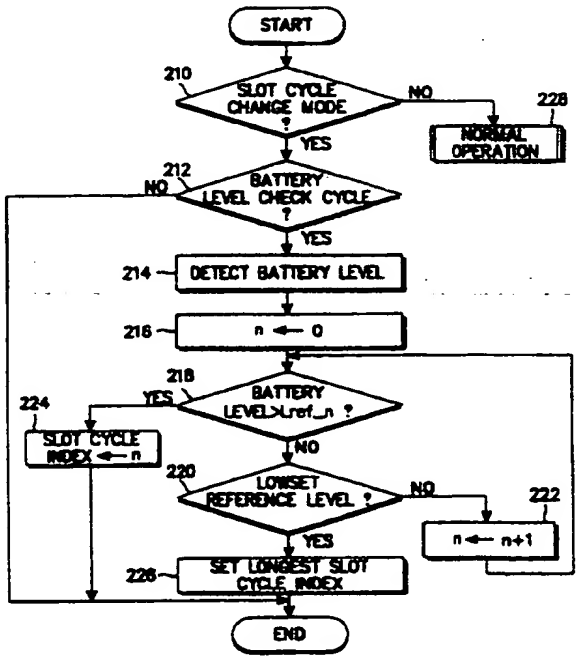

FIG. 2

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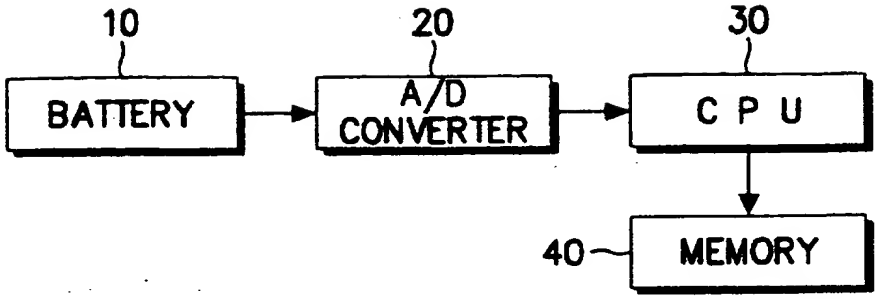

FIG. 1

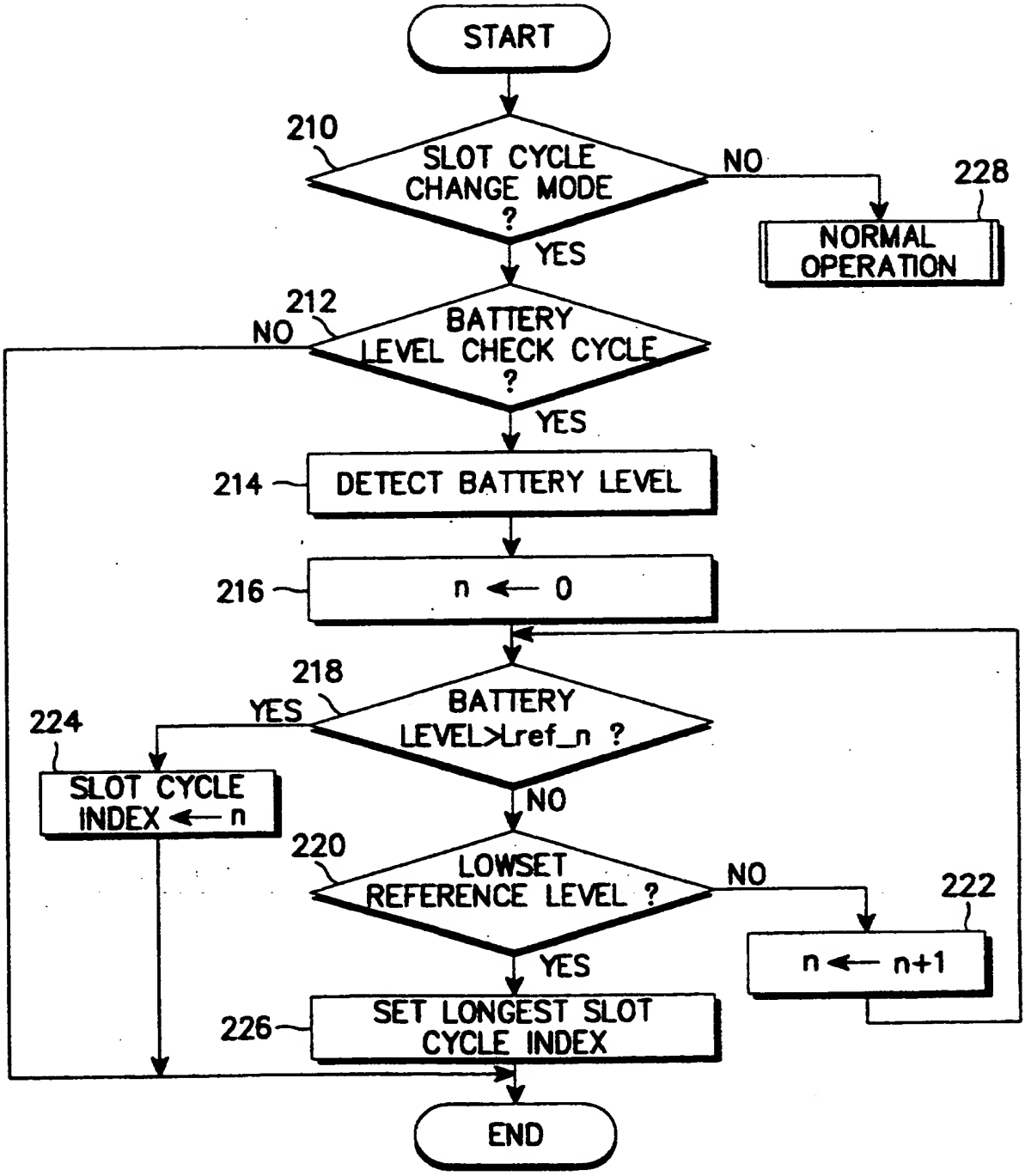
START
210
SLOT CYCLE CHANGE MODE ?
NO
228
NORMAL OPERATION
YES
212
NO
BATTERY LEVEL CHECK CYCLE ?
YES
214
DETECT BATTERY LEVEL
216
n ← 0
218
YES
BATTERY LEVEL>Lref_n ?
224
SLOT CYCLE INDEX ← n
NO
220
LOWSET REFERENCE LEVEL ?
NO
222
n ← n+1
YES
226
SET LONGEST SLOT CYCLE INDEX
END

FIG. 2

APPARATUS AND METHOD FOR EXTENDING BATTERY LIFE

The present invention relates to an apparatus and method for extending the battery life and, more particularly, to a mobile communication terminal comprising the apparatus and operable according to the method.

A mobile communication terminal, with which a moving user can communicate with a third party, includes a cellular phone, a PCS (Personal Communication Services) phone, a CT-2 (2nd generation Cordless Telephone), etc. The mobile communication terminal searches for a signal received from a base station in a specified cycle which is determined according to a slot cycle index. The process of performing such a search utilises battery power. The slot cycle index is set in a manufacturing process of a mobile communication terminal, and the user can change the slot cycle index by a man-machine interface (MMI) function. Conventionally, when the user unable to charge the battery for many hours, he uses the MMI function to extend the battery life. However, the user should check the battery state, every time he controls the slot cycle index by using the MMI function. Further, even though the user may check the battery state, the user is also required to understand the how controlling the slot cycle index to control the slot cycle index is related to the battery state.

It is an object of the present invention to at least mitigate the problems of the prior art.

Accordingly, a first aspect of the present invention provides a method for extending battery life of a mobile communication terminal which performs an activity at particular time intervals, the method comprising the step of detecting the current capacity of the battery; and varying the time interval according to the current capacity of the battery.

Advantageously, the present invention provides a method for controlling a slot cycle of a mobile communication

terminal according to the remaining capacity of the battery of the mobile communication terminal.

Preferably, an embodiment provides a method for extending battery life of a mobile communication terminal. The mobile communication terminal has a slot cycle index table for storing a plurality of reference levels and their corresponding slot cycle indexes. As a slot cycle change mode is set, the terminal detects a battery level in a prescribed battery level check cycle and compares the detected battery level with the reference levels in sequence. If the detected battery level is higher than a selected one of the reference levels, the terminal sets the slot cycle index to a value corresponding to the selected reference level.

A second aspect of the present invention provides an apparatus for extending battery life of a mobile communication terminal which performs an activity at particular time intervals, the apparatus comprising means for detecting the current capacity of the battery; and means for varying the time interval according to the current capacity of the battery.

Further, the terminal sets the slot cycle index so that it corresponds to a longest slot cycle, when the detected battery level falls outside, preferably below, a reference level range.

Embodiments of the present invention will now be described by way of example only with reference to the accompanying drawings in which:

figure 1 is a block diagram of an apparatus for extending the battery life of a battery of a mobile communication terminal; and

figure 2 is a flow chart illustrating a method for extending the battery life of a battery of a mobile communication terminal.

Figure 1 shows a block diagram of a device for extending the battery life of a battery of a mobile communication terminal. Referring to FIG 1, a rechargeable battery 10 provides the mobile communication terminal with an operating voltage, and an analog-to-digital (A/D) converter 20 converts an analog voltage signal of the battery 10 to a digital voltage signal. A central processing unit (CUP) 30 controls the overall operations of the mobile communication terminal according to a control program stored in a memory 40. In addition, the CPU30 sets the slot cycle index according to the digital voltage signal of the battery 10 received from the A/D converter 20. The memory 40 stores the control program of the CPU30 and various other data. In particular, the memory 40 has a slot cycle index table for storing the slot cycle indexes together with their corresponding reference levels, preferably reference battery voltage levels, as shown in Table 1.

Table 1

Slot Cycle Index	0	1	2	3	4	5	6	7
Reference Level (V)	7.2	6.9	6.7	6.5	6.3	6.1	5.9	5.7

In Table 1, though expressed as physical values, the reference levels are digital data which can be processed by software. Further, the voltage range between 7.2V and 5.7V defined by the reference levels represents a voltage range over which the mobile communication terminal can operate normally.

Figure 2 is a flow chart illustrating a method for extending the battery life of a battery of a mobile communication terminal. In figure 2, the CPU 30 determines the battery level at regular intervals when a slot cycle change mode is set, and controls the slot cycle index according to the detected battery level.

Referring to figure 2, the CPU 30 determines in step 210 whether the user has set the slot cycle change mode by using a keypad (not shown) of the mobile communication terminal. If it is determined that the user has set the slot cycle change mode, the CPU 30 checks at step 212 whether a battery level check cycle change mode is due, which allows the CPU 30 to check the state of the battery 10 at regular intervals. If it is determined in step 212 that the battery level check cycle is due, the CPU 30 determines the level of the battery 10 in step 214 by reading the digital voltage signal output from the A/D converter 20. Upon detection of the battery level, the CPU 30 sets a count value to zero in step 216. The count to compare in sequence the determined battery level with the reference levels of table 1.

Thereafter, the CPU 30 compares the detected battery level with the reference levels in sequence, beginning at the initial reference level Lref_0, to set an appropriate slot cycle index, through steps 218 to 226. Specifically, in step 218, the CPU 30 compares the detected battery level with the initial reference level Lref_0 (ie 7.2V in Table 1) corresponding to the slot cycle index (ie index 0 in Table 1) for the shortest slot cycle. As a result of the comparison, it if is determined that the detected battery level is equal to or less than the initial reference level Lref_0, the CPU 30 determines in step 220 whether the reference level Lref_0 is the lowest reference level (ie 5.7V in Table 1). If it is determined that the reference level Lref_0 is not the lowest reference level, the CPU 30 increases the count value, n, by one to select the next reference level Lref_1 in step 222 and returns to the step 218. In the step 218, the CPU 30 compares the detected battery level with the reference level Lref_1. As a result of the comparison, if the detected battery level is higher than the reference level Lref_1, the CPU 30 reads from the memory 40 the slot cycle index "1" corresponding to the reference level Lref_1 (ie 6.9V in Table 1) to set the slot cycle index to "1" in step 224. However, if it is determined in step 220 that the reference level

Lref_n is the lowest reference level, the CPU reads the slot cycle index "7" corresponding to the longest slot cycle to set the slot cycle index to "7".

In summary, if the detected battery level is higher than the currently indexed reference level in step 218, the CPU 30 sets the slot cycle index to the index value of the currently indexed reference level in the step 224. However, if the detected battery level is equal to or less than the reference level, the CPU 30 iteratively increases the count value, n, by one through the steps 220 and 222 and repeats the processing from step 218 until the reference level is lower than the detected battery level.

Referring to Table 1, if the detected battery level is 6.4V, the CPU 30 compares the detected battery level of 6.4V with the reference levels Lref_0-Lref_4 of 7.2V, 6.9V, 6.7V, 6.5V and 6.3V in sequence. When comparing the battery level of 6.4V with the reference level of 6.3V, the CPU 30 determines that the battery level is higher than the reference level Lref_4 and sets the slot cycle index to "4" which is the index value of the corresponding reference level, Lref_4, of 6.3V.

It is understood that the above stated function can be also embodied to perform repeatedly during a battery level check period by allowing step 224 or step 226 to return to step 212 even though the above embodiment illustrates the function performing a one battery level check every battery level check period.

As described above, the mobile communication terminal of the invention can reduce the battery consumption by controlling the slot cycle index according to the battery level, thereby contributing to extension of the limited battery life.

While the invention has been shown and described with

reference to certain preferred embodiment thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

CLAIMS

1. A method for extending battery life of a mobile communication terminal which performs an activity at particular time intervals, the method comprising the step of detecting the current capacity of the battery; and varying the time interval according to the current capacity of the battery.

2. A method as claimed claim 1, wherein the particular time interval corresponds a slot cycle of the mobile communication terminal; and the step of varying the time interval comprises the step of setting the slot cycle to a predetermined value.

3. A method as claimed in either of claims 1 or 2, wherein the step of detecting the current capacity of the battery comprises the step of
detecting the current battery voltage level.

4. A method as claimed in claim 3, wherein the mobile communication terminal comprises a slot cycle index table for storing a plurality of battery voltage levels which are accessed using corresponding slot cycle indexes, and the step of varying the particular time interval comprises the step of comparing the detected battery voltage with the of the plurality of battery voltage levels; and
setting the slot cycle index to the slot cycle index corresponding to the battery voltage level of the plurality of battery voltage levels which is closest to but less than the detected battery voltage level.

5. A method as claimed in claim 4, wherein the step of varying comprises the step of
setting the slot cycle index corresponding to a longest slot cycle time interval, when the detected battery voltage level falls outside of a reference level range of battery voltage

levels.

6. A method as claimed in any preceding claim, wherein in the step of detecting is peformed periodically.

7. A method as claimed in any preceding claims, wherein the step of detecting is performed according to whether or not a first criterion is satisfied.

8. A method as claimed in claim 7, wherein the predetermined criterion is that a slot change mode has been set.

9. Apparatus for extending battery life of a mobile communication terminal which performs an activity at particular time intervals, the apparatus comprising means for detecting the current capacity of the battery; and means for varying the time interval according to the current capacity of the battery.

10. Apparatus as claimed claim 9, wherein the particular time interval corresponds a slot cycle of the mobile communication terminal; and the means for varying the time interval comprises the step of setting the slot cycle to a predetermined value.

11. Apparatus as claimed in either of claims 9 or 10, wherein the means for detecting the current capacity of the battery comprises
means for detecting the current battery voltage level.

12. Apparatus as claimed in claim 11, wherein the mobile communication terminal comprises a slot cycle index table for storing a plurality of battery voltage levels which are accessed using corresponding slot cycle indexes, and the means for varying the particular time interval comprises means for comparing the detected battery voltage with the of the plurality of battery voltage levels; and

means for setting the slot cycle index to the slot cycle index corresponding to the battery voltage level of the plurality of battery voltage levels which is closest to but less than the detected battery voltage level.

13. Apparatus as claimed in claim 12, wherein the means for varying comprises
means for setting the slot cycle index corresponding to a longest slot cycle time interval, when the detected battery voltage level falls outside of a reference level range of battery voltage levels.

14. Apparatus as claimed in any of claims 9 to 13, wherein in the means for detecting is operable periodically.

15. Apparatus as claimed in any of claims 9 to 14, wherein the means for detecting is operable according to whether or not a first criterion is satisfied.

16. Apparatus as claimed in claim 15, wherein the predetermined criterion is that a slot change mode has been set.

17. A method for extending battery life substantially as described herein with reference to and/or as illustrated in the accompanying drawings.

18. Apparatus for extending battery life substantially as described herein with reference to and/or as illustrated in the accompanying drawings.

The Patent Office

INVESTOR IN PEOPLE

Application No: GB 9816270.4 **Examiner:** Jared Stokes
Claims searched: 1 to 18 **Date of search:** 16 December 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): G4H (RCA)
H4L (LECTP)

Int Cl (Ed.6): H04M (1/72)
H04Q (7/18, 7/32)

Other: On-Line - WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	EP 0 666 676 A2 (AMD) See abstract	-
X,Y	US 5 465 394 (Pinault et al.) See whole document	X: 1,2,6,7,9, 10,14,15 Y: 3,11
Y	US 5 095 308 (Hewitt) See abstract, column 7 lines 14-22	3,11
X	WPI Abstract Accession No.93-259006/199332 & ZA9205762A (Smith) 31.07.92 (see abstract)	1,9

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.